PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-197614
(43)Date of publication of application : 31.07.1998

(51)Int.Cl. G01R 33/02
H04N 9/29

(21)Application number : 08-357870
(22)Date of filing : 28.12.1996

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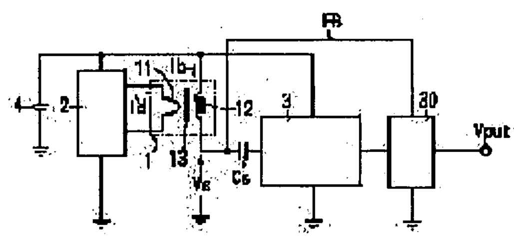
(54) MAGNETIC DETECTION CIRCUIT

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance accuracy of circuit output characteristics for external field strength by making the circuit output characteristics for external field strength insusceptible to the ambient temperature or fluctuation in the characteristics of a magnetic sensor as much as possible.

SOLUTION: The magnetic detection circuit comprises a magnetic sensor 1, a drive circuit 2, a signal processing circuit 3 and a constant current source 30. The magnetic sensor 1 comprises an exciting coil 11 and a detection coil 12. The exciting coil 11 and the detection coil 12 are coupled electromagnetically each other through a magnetic body 13 constituting a magnetic circuit. The drive circuit 2 supplies a periodic current to the exciting coil 11 thus exciting the coil 11. The signal processing circuit 3 processes a signal VS supplied from the detection coil 12 and outputs the processed signal. The constant current source 30 performs negative feedback operation for a signal being supplied from the detection coil 12 to the signal processing circuit 3 based on a signal outputted from the signal processing circuit 3.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a magnetic detector. The magnetic detector concerning this invention can be used for a means to negate the effect of earth magnetism to the Braun tube etc., in the image display device which displays an image using the Braun tube.
[0002]
[Description of the Prior Art] In the image display device which displays an image using the Braun tube, the electron beam generated with the electron gun is deflected by the field of a deflecting yoke to level and a perpendicular direction, and in a fluorescent substance, when this part that hit emits light, an image is displayed. However, since the electron beam discharged from the electron gun has distance until it reaches a fluorescent substance, in response to the effect of earth magnetism, the orbit will often shift, and it will produce turbulence of an image.
[0003] With an image display device, the direction of earth magnetism and its strength are detected from the former, using an auto cancellation system as a means to solve this problem, the field of the direction of earth magnetism and an opposite direction is generated, and the technique of amending turbulence of the image by earth magnetism is taken. The magnetic detector which detects the direction and strength of earth magnetism is required of an auto cancellation system.
[0004] Including a magnetometric sensor, a magnetometric sensor is equipped with an exiting coil and a sensing coil, supplies the alternating current for excitation, or pulse current to an exiting coil, and catches the electrical potential difference produced at the time of the start of an alternating current or pulse current, or falling in a sensing coil, and this conventional kind of magnetic detector changes it into a direct current signal, is amplified in an amplifying circuit, and acquires a voltage signal. This voltage signal is transformed into a current signal by the V/I transducer, the acquired current is supplied to a cancellation coil, and a cancellation field is generated. A cancellation coil is formed in the shape of [surrounding the Braun tube] a loop formation.
[0005]
[Problem(s) to be Solved by the Invention] It is that one of the troubles of the magnetic detection means used for the auto cancellation system mentioned above is influenced by the B-H property by the variation and the temperature characteristic of a B-H property of a magnetometric sensor as it is of change, and it becomes the output precision of the magnetic detector to external magnetic field reinforcement, and the cause of degradation since the output characteristics of the magnetometric sensor to external magnetic field reinforcement are decided by the B-H property of a magnetometric sensor.
[0006] The B-H property of a magnetometric sensor is [that it is easy to change by the variation and the temperature characteristic resulting from the ingredient of the magnetic substance which constitutes a magnetic circuit, structure, etc.] unstable. For this reason, by approach like the conventional example, it was directly influenced of the instability of a B-H property, and the property of the sensor output Vs over external magnetic field reinforcement is easy to change and was also unstable. And in order to change the signal acquired from the magnetometric sensor into the electrical-potential-difference value

made into the purpose, it will amplify, fluctuation of the above-mentioned magnetometric sensor output will be amplified, and it will usually come out in a magnetic detector.
[0007] It is that the technical problem of this invention offers the magnetic detector in which the circuit output characteristics to external magnetic field reinforcement made effect by the property variation of an ambient temperature or a magnetometric sensor hard to be influenced as much as possible and which aimed at the improvement in precision of circuit output characteristics to external magnetic field reinforcement.
[0008]
[Means for Solving the Problem] In order to solve the technical problem mentioned above, the magnetic detector concerning this invention includes a magnetometric sensor, a drive circuit, a digital disposal circuit, and a constant current source.
[0009] The electromagnetic coupling of said exiting coil and said sensing coil of each other is carried out through the magnetic substance with which said magnetometric sensor constitutes a magnetic circuit, including an exiting coil and a sensing coil at least. Said drive circuit supplies and excites a periodicity current to said exiting coil.
[0010] Said digital disposal circuit processes and outputs the signal supplied from said sensing coil. Said constant current source performs negative feedback actuation to the signal supplied to said digital disposal circuit from said sensing coil based on the signal which supplies a bias current to said sensing coil, and is supplied from said digital disposal circuit.
[0011] If periodicity currents, such as an alternating current or pulse current, are supplied to an exiting coil from a drive circuit and an exiting coil is excited, induction of the electrical potential difference will be carried out to a sensing coil at the time of the start of the supplied periodicity current, or falling. A digital disposal circuit processes and outputs the signal supplied from a sensing coil.
[0012] The magnetic detector concerning this invention is further equipped with a constant current source. Said constant current source performs negative feedback actuation to the signal supplied to said digital disposal circuit from said sensing coil based on the signal given from said digital disposal circuit while supplying a bias current to said sensing coil. According to this configuration, when external magnetic field strength changes, negative feedback can be applied to flux density change drawn in the magnetic substance contained in the magnetic circuit of a magnetometric sensor, fluctuation of the circuit output resulting from fluctuation of the property of a magnetometric sensor can be suppressed, and precision can be raised.
[0013]
[Embodiment of the Invention] Drawing 1 is the electrical diagram of the magnetic detector concerning this invention. The magnetic detector concerning this invention includes a magnetometric sensor 1, the drive circuit 2, a digital disposal circuit 3, and a constant current source 30 so that it may illustrate. The electromagnetic coupling of an exiting coil 11 and the sensing coil 12 of each other is carried out through the magnetic substance 13 with which a magnetometric sensor 1 constitutes a magnetic circuit, including an exiting coil 11 and a sensing coil 12 at least. The drive circuit 2 supplies and excites periodicity currents, such as an alternating current or pulse current, to an exiting coil 11. 4 is DC power supply and Cs is a capacitor for AC couplings.
[0014] A digital disposal circuit 3 processes and outputs the voltage signal Vs supplied from a sensing coil 12. In the magnetic detector of the above-mentioned configuration, if pulse current Id (refer to drawing 2 (a)) is supplied to an exiting coil 11 from the drive circuit 2 and an exiting coil 11 is excited, induction of the electrical potential difference Vs of peak value Vsp will be carried out to a sensing coil 12 to the start Tr of the supplied pulse current Id, or the timing of falling Tf (refer to drawing 2 (b)). A digital disposal circuit 3 processes and outputs the voltage signal Vs supplied from a sensing coil 12.
[0015] A constant current source 30 performs negative feedback actuation to the electrical potential difference Vs supplied to a digital disposal circuit 3 from a sensing coil 12 based on the signal given from a digital disposal circuit 3 while it supplies a bias current to a sensing coil 12 and produces a circuit output Vout. According to this configuration, fluctuation of the circuit output Vout resulting from fluctuation of the property of a magnetometric sensor 1 can be suppressed, and precision can be raised.

Next, this point is explained in more detail.
[0016] The value of the sensor output Vs is acquired by the following law of electromagnetic induction.
Vs=N (deltaphi/deltat)
= N (**BxS/deltat) (1)
deltaphi=**BxS =(mu b-Hb-mu a-Ha) xS = (Lxdelta Id)/N (2)
here -- Vs:magnetometric sensor -- resonance cross section deltaId: of the amount S:magnetic substance of flux reversal in the magnetic substance within output voltage N:turn ratio delta phi/delta t:time amount deltat -- effective-permeability ** B=mu b-Hb-mu a-Ha which changed with the bias field mub:excitation produced in the magnetic substance by effective-permeability Hb:excitation of the magnetic substance in bias magnetic-field-strength mua:Ha generated in the flux density variation Ha:magnetic substance generated in the amplitude **B:magnetic substance of an exciting current (3)
In the magnetic detector shown in drawing 1 , the electromagnetic coupling of an exiting coil 11 and the sensing coil 12 is carried out through the magnetic substance 13 which constitutes a magnetic circuit, and the sensor output Vs is obtained according to the mutual induction effect between an exiting coil 11 and a sensing coil 12. The exiting coil 11 was made to generate flux density variation **B of the magnetic circuit included in a magnetometric sensor 1 by passing the exciting current Id which consists of a pulse or alternating current from the drive circuit 2, and as shown in drawing 2 (a), the output voltage Vs of a magnetometric sensor 1 has been obtained to start Tr of pulse current Id, and the timing of falling Tf.
[0017] Output voltage Vs is proportional to flux density variation **B, as shown in an upper type. This output Vs is the pulse train of amphipathy, as shown in drawing 2 (b), and only the signal by the side of forward is detected by the hold circuit in practice. In a magnetometric sensor 1, flux density variation **B in the magnetic substance which constitutes a magnetic circuit is proportional to the difference of product mua-Ha of the bias field Ha and effective-permeability mua, and product mub-Hb of the magnetic field strength Hb by excitation, and effective-permeability mub, as shown in the above-mentioned (3) formula.
[0018] Drawing 3 shows the operating characteristic (conventional property) of a magnetometric sensor negative feedback or in case there is nothing **, and drawing 4 shows the operating characteristic of the magnetometric sensor of this invention to which negative feedback was applied. Drawing 3 and drawing 4 show a part of B-H property of the magnetic circuit which constitutes a magnetometric sensor, and magnetic field strength Hs (A/m) is taken along an axis of abscissa, and they have taken flux density B (T) along the axis of ordinate.
[0019] In drawing 3 , the external magnetic field strength H shall change from 0 (Oe) to Ha1 (Oe). If the external magnetic field reinforcement H changes, a bias field will also change, but from flux density variation **B1 at the time of the bias point H= 0 of a basis, small flux density variation **B-2 is obtained from the non-linearity of a B-H property, and as shown in the above-mentioned (1) formula, the sensor output Vs proportional to this arises from it. Magnetic field strength Hb1 and Hb2 is the magnetic field strength by excitation. Therefore, if a magnetometric sensor 1 is placed into an external magnetic field H, the sensor output Vs according to each external magnetic field reinforcement will be obtained.
[0020] However, by the above-mentioned conventional method, since the property of the sensor output Vs over the external magnetic field reinforcement H is decided by the B-H property of a magnetometric sensor 1, it will be influenced by the B-H property by the variation and the temperature characteristic of a B-H property of a magnetometric sensor 1 as it is of change. For this reason, it had become the output precision of the magnetic detector to external magnetic field reinforcement, and the cause of degradation.
[0021] Next, in drawing 4 , the situation of the operating point change on the B-H property of the magnetometric sensor 1 to the external magnetic-field-strength change by this invention is shown. Magnetic field strength Ha is bias magnetic field strength. In this invention, a bias current Ib is passed to a sensing coil 12. A bias current Ib is supplied by the constant current source 30. The relation between the magnetic field strength Hs generated in the magnetic substance of a magnetometric sensor 1 at this

time and the bias current Ib passed to a sensing coil 12 is in the proportionality described below from Ampere's circuital law.
[0022] Hs=(NxIb)/l, however the number of turns l of the N:sensing coil 12: In magnetic-path Nagamoto invention, based on the signal outputted from a digital disposal circuit 3, a constant current source 30 controls a bias current Ib, and performs negative feedback actuation to the sensor output Vs. This negative feedback actuation leads to narrowing the bias point change field on the B-H property equivalent to the variability region of external magnetic field reinforcement on the B-H property of a magnetometric sensor 1, and does not need to use the nonlinear field where the B-H property of the magnetic substance contained in a magnetometric sensor 1 is unstable compared with the conventional example. That is, compared with the case where negative feedback is not applied, it can be made to be able to operate in the more nearly linear field on the B-H property of a magnetometric sensor 1, and the sensor output Vs to external magnetic field strength can be made into a linear, and the property of a circuit output Vout can also be made into a linear.
[0023] The change field of the bias point describe above can be narrow further , it be necessary to use an unstable field on the B-H property of a magnetometric sensor 1 , and the output of the magnetic detector to external magnetic field strength can be stabilize , so that property fluctuation of a circuit output Vout be large by property fluctuation of a magnetometric sensor 1 so that the amplification degree of an amplifying circuit be raised , but the amplification degree of a circuit will be raise in the conventional example , if the negative feedback actuation to the sensor output Vs be make to perform like this invention . In addition, in the example shown in drawing 1 , although the circuit output Vout has been obtained from the constant current source 30, it may be obtained from a digital disposal circuit 3.
[0024] Drawing 5 shows the still more concrete example of the magnetic detector concerning this invention. In drawing, the same reference mark is given to the same component as drawing 1 .
[0025] The digital disposal circuit 3 includes a hold circuit 31 and inversed amplification 32. A hold circuit 31 holds the sensor output Vs supplied from the sensing coil 12 of a magnetometric sensor 1. Inversed amplification 32 carries out reversal magnification of the signal supplied from the hold circuit 31, and supplies it to a constant current source 30. According to the reversal magnification signal supplied from inversed amplification 32, a constant current source 30 controls a bias current Ib, and performs negative feedback actuation to the sensor output Vs.
[0026] In the example, the exiting coil 11 of a magnetometric sensor 1 is constituted by the conductive magnetic substance. The example is shown in drawing 6 . An exiting coil 11 is constituted by the conductive magnetic substance of 1 turn, and the surroundings of an exiting coil 11 are looped around the sensing coil 12. The magnetometric sensor 1 of such a configuration is indicated by JP,2-62986,A, JP,2-62987,A, etc., is lightweight and has the outstanding features that sensibility is very high. About the example of the conductive magnetic substance which constitutes an exiting coil 11, Co system amorphous alloyed wire indicated by the advanced-technology reference mentioned above can be used. What was indicated by these advanced-technology reference can be used as it is also about structure, or some modification can be added and used. The conductive magnetic substance which constitutes an exiting coil 11 turns into the magnetic substance which constitutes a magnetic circuit. The external magnetic field H detected is a field component parallel to the die-length direction of an exiting coil 12.
[0027] In the magnetic detector shown in drawing 5 , by the drive circuit 2, the alternating current for excitation or pulse current is supplied to the conductive magnetic substance which constitutes the excitation winding 11 of a magnetometric sensor 1, and the sensor output Vs is obtained from a sensing coil 12 at the time of the start of this current, and falling. The sensor output Vs is changed into direct current voltage Vb by the hold circuit 31. Direct current voltage Vb is supplied to inversed amplification 32.
[0028] In inversed amplification 32, reversal magnification of the direct current voltage Vb is carried out. A reversal magnification output is sent to a constant current source 30. A constant current source 30 passes a bias current Ib to a sensing coil 12, and performs negative feedback actuation to the sensor output Vs according to the output from inversed amplification 32.
[0029] Therefore, in a magnetometric sensor 1, negative feedback is applied to the flux density drawn in

the conductive magnetic substance which constitutes excitation winding 11, the nonlinear field where a B-H property is unstable can be avoided, and a magnetometric sensor 1 can be operated. Thereby, a magnetic detector output can suppress the effect of the property change by the property variation and temperature of a magnetometric sensor 1.
[0030] Drawing 7 shows the still more concrete electrical diagram of the example shown in drawing 5 . A hold circuit 31 is a peak hold circuit, and contains NPN transistor Q2 and the capacitor C1. Resistance R4 and R5 and zener diode D1 constitute the bias circuit of a transistor Q2. The sensor output Vs is supplied to the base of a transistor Q2 through Capacitor Cs. A transistor Q2 flows with the sensor output Vs of a plus side pulse among bipolar pulses (refer to drawing 2 (b)), and a capacitor C2 is charged by the flow of a transistor Q2. Thereby, the sensor output Vs is held as terminal voltage Vb of a capacitor C2. Although the sensor output Vs will change according to this if external magnetic field reinforcement changes, in proportion to this, the electrical potential difference Vb held in a hold circuit 31 also changes.
[0031] Inversed amplification 32 has NPN transistor Q3, carries out reversal magnification and outputs the maintenance electrical potential difference Vb of the hold circuit 31 impressed to the base. Resistance R1 is connected to the emitter of a transistor Q3, resistance R2 is connected to the collector, and reversal magnification is outputted from a collector. In actuation, the electrical potential difference which deducted a part for the voltage drop between base-emitters of a transistor Q3 (about 0.7v) from the electrical potential difference Vb currently held by the hold circuit 31 is impressed to resistance R1. At this time, the twice (R2/R1) as many voltage drop Vr2 as the electrical potential difference impressed to resistance R1 will arise in the both ends of resistance R2. Therefore, the output Vc of inversed amplification 32 serves as a value (Vin-Vr2) which deducted the voltage drop Vr2 from the power-source input voltage Vin. In the magnetic detector of this invention, in order to obtain the external magnetic field reinforcement and the relation of a circuit output which are made into the purpose, the amplification degree (- R2/R1) of inversed amplification 32 is adjusted, and this performs reversal magnification to change of the electrical potential difference Vb of a hold circuit 31.
[0032] The constant current source 30 contains NPN transistor Q4, and the output voltage Vc of inversed amplification 32 is supplied to the base. Furthermore, the collector of a transistor Q4 is tied through the negative feedback circuit FB at the node of a sensing coil 12 and Capacitor Cs. Furthermore, the resistance R3 for I/V conversion is connected to an emitter, and it is. The detection output voltage Vout is obtained as terminal voltage of resistance R3. The detection output voltage Vout serves as a value which fell by the voltage drop between base-emitters of a transistor Q4 (about 0.7v) from the output voltage Vc of inversed amplification 32, and reacts to change of an electrical potential difference Vc. The bias current Ib which returns becomes the value decided by Vout/R3.
[0033] Although the bias current Ib of a sensing coil 12 also changes in proportion to the output Vc of the inversed amplification 32 according to external magnetic field reinforcement, as already explained, the bias current Ib will have given negative current feedback actuation to the sensing coil 12 about the sensor output Vs. Therefore, negative feedback is applied to the flux density drawn in the conductive magnetic substance 11 of a magnetometric sensor 1, the field where a B-H property is unstable can be avoided, and a magnetometric sensor 1 can be operated. For this reason, a circuit output Vout can be obtained in the form where the effect of the property change by the property variation and temperature of a magnetometric sensor 1 was suppressed.
[0034] Next, a concrete measurement result explains the effectiveness of the negative feedback actuation in this invention.
[0035] The graph and drawing 9 which show the relation between the external magnetic field strength H when drawing 8 changes the rate of negative feedback, and the sensor output Vs show the gaging system offered in order to obtain the data of drawing 8 . In drawing 9 , the same reference mark is given to the same component as drawing 5 . The reference mark 30 shows the constant current source. The bias current Ib which flows to a sensing coil 12 is controlled by the constant current source 30, and negative feedback actuation to the sensor output Vs is performed. The bias current Ib of the sensing coil 12 in the external magnetic field reinforcement H= 0 (Oe) is external magnetic field reinforcement. - It was the

range of 0.6-0.6 (Oe), and it was made to change like a feedback ratio 0 (conventional example), -1 mA/Oe, and -3 mA/Oe, and the property of the sensor output Vs over the external magnetic field reinforcement H at this time was measured.
[0036] In the curve L11, the property at the time of a feedback ratio 0 (conventional example) and a curve L12 show the property at the time of feedback ratio-1 mA/Oe, and the curve L13 shows the property at the time of feedback ratio-3 mA/Oe, respectively. The properties L12 and L13 when applying negative feedback are linears compared with the property L11 of the conventional example of a feedback ratio 0. Although the inclination of a property becomes small so that the rate of negative feedback is gathered, linearity improves. This is because the bias point variability region on the B-H property of a magnetometric sensor 1 is narrow with negative feedback actuation.
[0037] Avoid the unstable field on the B-H property of a magnetometric sensor 1, it is made to operate, and the magnetometric sensor output characteristics to an external magnetic field change on the strength when the property of a magnetometric sensor 1 changes are stabilized, so that in other words a linear property is approached.
[0038] Drawing 10 - drawing 12 are graphs which show the external magnetic field strength H at the time of changing a feedback ratio, and relation with a circuit output Vout. When changing the external magnetic field strength H from 0 (Oe) to 0.3 (Oe), output change deltaVout=1.0v is obtained, and the data of drawing 10 - drawing 12 plot the property of a sample that inclinations are max and min, and are obtained. In drawing 10 , the property at the time of a feedback ratio 0 (conventional example) and drawing 11 show the property at the time of feedback ratio-1 mA/Oe, and drawing 12 shows the property at the time of the feedback ratio of -3mA, respectively.
[0039] As magnetic detector output characteristics are shown by drawing 11 and drawing 12 by this invention, compared with a property, it turns out that the variation in the circuit output characteristics by the property variation of a magnetometric sensor 1 becomes small with the rise of a feedback ratio, and linearity is improved conventionally which is shown in drawing 10 , so that it may illustrate.
[0040] Drawing 13 - drawing 15 are graphs which show the relation of the external magnetic-field-strength H (Oe) and the circuit output Vout to ambient temperature. The graph with which drawing 13 shows the property at the time of a feedback ratio 0 (conventional example), the graph with which drawing 14 shows the property at the time of feedback ratio-1 mA/Oe, and drawing 15 are graphs which show the property at the time of feedback ratio-3 mA/Oe.
[0041] Conventionally which is shown in drawing 13 , compared with the property, as a circuit output Vout property is shown by drawing 14 and drawing 15 by this invention, property change of the circuit output Vout by ambient temperature is suppressed small. This inclination becomes strong with the rise of a feedback ratio.
[0042] In this invention, in consideration of the property variation of a magnetometric sensor 1, the above-mentioned rate of negative feedback was increased, so that it was enough to make the above-mentioned circuit output characteristics into a linear, and in external magnetic field reinforcement and relation with a circuit output Vout, in order to obtain the target inclination, the above-mentioned circuit output characteristics have been obtained by adjusting the amplification degree (- R2/R1) of inversed amplification 32.
[0043] In the property of the above-mentioned circuit output, linearity can be given more, by the property variation and the temperature characteristic of a magnetometric sensor 1, even if the property of a magnetometric sensor 1 changes, effect can be made hard to receive and the detection precision of magnetic field strength can be raised, so that the rate of negative feedback is increased and change width of face of the bias point describing above is narrowed.
[0044] Drawing 16 is the electrical diagram showing another example of the magnetic detector concerning this invention. In drawing, the same reference mark is given to the same component as drawing 5 . The description of this example is having carried out as [add / including the magnetic-bias means 5 / to the magnetic circuit 13 included in a magnetometric sensor 1 by the magnetic-bias means / one direction magnetic bias]. A desirable setup of magnetic bias is setting the bias magnetic field strength of a magnetic circuit 13 as the loose field of change of the effective permeability.

[0045] Drawing 17 shows the more concrete electrical diagram of the magnetic detector shown in drawing 16 . In drawing 17 , the same reference mark is given to the same component as drawing 7 . The magnetic-bias means 5 uses the field produced according to a current. Resistance Rb is connected between the node of the detection coil 12, the negative feedback circuit FB, and Capacitor Cs, and a ground, and, more specifically, a bias current Ib2 is passed to a sensing coil 12 by this resistance Rb.
[0046] According to the above-mentioned configuration, in the magnetic field strength Hs in the magnetic substance of the magnetometric sensor 1 generated according to a bias current Ib2, and relation with the effective permeability mu, a bias current value is set up so that it may come to the loose field of mu value change. For this reason, the negative feedback stabilized to the flux density change in the magnetic substance produced when external magnetic field strength changes can be applied, and the circuit output Vout stabilized to the variation in the property of a magnetometric sensor 1 can be obtained.
[0047] Drawing 18 is drawing showing the operating characteristic of the magnetic detector shown in drawing 16 and drawing 17 . Drawing 18 (a) shows a B-H property, and drawing 18 (b) shows the permeability change property, respectively.
[0048] As already explained, negative feedback is applied to a sensing coil 12 for a bias current Ib to a sink and the sensor output Vs. However, as shown in drawing 18 (a), when it is set as the bias field H1 according to a bias current Ib and changes with exciting currents Id from magnetic field strength H1 to H2, this variability region is the large field of the effective permeability mu, as shown in drawing 18 (b). Although flux density variation **B-2 from which this is obtained is large, it means that flux density variation **B changed by change of a B-H property also becomes large. This also influences the sensor output Vs and leads to property degradation of a circuit output Vout. Specifically, a circuit output will also vary by the property variation of a magnetometric sensor 1.
[0049] It not only applies negative feedback to a sensing coil 12, but in the example shown in drawing 16 and drawing 17 , it adds one direction magnetic bias with the magnetic-bias means 5. Thereby, the bias point by negative feedback can be made to be able to shift to the point of the magnetic field strength Hc1 of drawing 18 , and negative feedback actuation can be made to perform in the loose field of mu value change in the relation between the bias field Hs and an effective-permeability mu value.
[0050] The magnetic-bias means 5 consists of examples shown in drawing 17 as a constant current source for bias. Negative feedback by the constant current source 30 is performed to a sensing coil 12 focusing on a sink and this bias current Ib2 in a bias current Ib2 at the constant current source 5 for bias using Resistance Rb. In the example of drawing 17 , since it also has the constant current source 30 for negative feedback actuation, the bias current Ib it is decided by the sum of the bias current Ib2 which becomes settled by (Vin/Rb), and the bias current Ib1 which becomes settled by (Vout/R3) that will be a sensing coil 12 will flow. The constant current source 30 for negative feedbacks and two constant current sources 5 for bias prepared for acquiring the target property as external magnetic field reinforcement and a property of a circuit output Vout, and if the target property is acquired, one or at least two constant current sources 30 and 5 or more will not matter.
[0051] According to the example shown in drawing 16 and drawing 17 , as shown in drawing 18 (a), compared with a negative feedback actuation independent case, the small field of flux density variation **Ba generated according to an exciting current Id on the B-H property of a magnetometric sensor 1 will be used, fluctuation of flux density variation **B by property fluctuation of a magnetometric sensor 1 can be lessened, and circuit output fluctuation which originates in the property variation of a magnetometric sensor 1 especially can be made small. Even if it means that this changes a bias point in a more nearly linear field on the B-H property of the magnetometric sensor 1 which is a non-line type from the first, this bias point change field turns into a more nearly linear field by this and a bias point changes with change of external magnetic field reinforcement, the sensor output Vs obtained becomes linear and a circuit output Vout becomes a linear. It can be said that variation in the circuit output Vout resulting from the property variation of a magnetometric sensor 1 is made few, so that in other words a linear property is acquired. With reference to a concrete measurement result, the effectiveness is explained below.

[0052] Drawing in which drawing 19 shows the relation between the external magnetic field strength H and the sensor output Vs, and drawing 20 show the measuring circuit Fig. offered in order to obtain the data of drawing 19 .
[0053] The data of drawing 19 are drawing showing the relation between the external magnetic field strength H which makes a parameter the current Ib decided by the sum of the bias current Ib2 which becomes settled by (Vin/Rb), and the bias current Ib1 which becomes settled by (Vout/R3), and the sensor output Vs, and Current Ib was selected like 0mA, 1.0mA, 2.0mA, and 4.0mA.
[0054] The inclination of a property becomes small, so that the bias current Ib which flows to a sensing coil 12 becomes large, as the data of drawing 19 show. This is because the bias point is moving to the loose field of change of the effective permeability mu to the bias magnetic field strength Hs as explained with reference to drawing 18 , the inclination of a property becomes small and its linearity improves, so that a bias current Ib is increased and it has a bias point describing above to the loose field of mu value change.
[0055] Drawing 21 - drawing 24 show the external magnetic field strength H at the time of changing a bias current Ib, and relation with a circuit output Vout in the example shown in drawing 17 . When changing the external magnetic field strength H from 0 (Oe) to 0.3 (Oe), output change deltaVout=1.0v is obtained, and the data of drawing 21 - drawing 24 plot the property of a sample that inclinations are max and min, and are obtained. In the property at the time of Ib=0 (conventional example), and drawing 22 , the property at the time of Ib=1.0mA and drawing 23 show the property at the time of Ib=2.5mA, and drawing 24 shows [drawing 21] the property at the time of Ib=5.0mA, respectively.
[0056] As magnetic detector output characteristics are shown by drawing 22 - drawing 24 by this invention, compared with a property, it turns out that the variation in the circuit output characteristics by the property variation of a magnetometric sensor 1 becomes small with increase of a bias current Ib, and linearity is improved conventionally which is shown in drawing 21 , so that it may illustrate.
[0057] In this invention, it can adjust so that the external magnetic field on-the-strength-circuit output characteristics which target a bias current Ib to the property variation of a magnetometric sensor 1 may be obtained. Moreover, in order to acquire the above-mentioned property made into the purpose although the inclination of the property of the sensor output Vs becomes small so that a bias current Ib2 is increased, the amplification degree (- R2/R1) of inversed amplification 32 is adjusted. Since it can have a bias point describing above to the loose field of the change to the bias magnetic field strength of the effective-permeability mu value of a magnetometric sensor 1 so that a bias current Ib2 is increased and amplification degree is raised, variation in the circuit output characteristics by the property variation of a magnetometric sensor 1 can be lessened, and linearity can be obtained.
[0058] Drawing 25 shows another example of the magnetic detector concerning this invention. The description of this example is that the magnetic-bias means 5 becomes with a magnet. It is the direction as the field by the bias current Ib where the field with a magnet is the same, therefore the same operation effectiveness can be acquired with drawing 16 and drawing 17 having explained.
[0059] Next, the field cancellation equipment using the magnetic detector concerning this invention is explained. Drawing 26 shows an example of the Braun tube currently used for the image display device.
[0060] The electron beam 62 generated with the electron gun 61 of the Braun tube 6 is deflected by the field of a deflecting yoke 63 to level and a perpendicular direction, and in a fluorescent substance 64, when this part that hit emits light, an image is displayed. However, since the electron beam discharged from the electron gun has distance until it reaches a fluorescent substance 64, in response to the effect of earth magnetism, the orbit will often shift, and it will produce turbulence of an image.
[0061] In an image display device, field cancellation equipment generates the field (cancellation field) of the direction of earth magnetism, and an opposite direction, and is used as a means to amend turbulence of the image by earth magnetism.
[0062] Drawing 27 shows an example of an image display device which used field cancellation equipment 6. In this system, earth magnetism H3 is detected in the magnetic detecting element 7, a current is supplied to the cancellation coil 8 wound around the perimeter of the Braun tube 6, and the field H4 which cancels earth magnetism H3 according to the current which flows in the cancellation coil

8 is generated.
[0063] Drawing 28 is the block diagram of magnetic cancellation equipment using the magnetic detector concerning this invention as a magnetic detecting element 7. In drawing 28 , the same reference mark is given to the same component as drawing 1 , and explanation is omitted.
[0064] The circuit output Vout of the magnetic detector 71 concerning this invention is supplied to the cancellation coil 8 through the coil drive circuit 72. And earth magnetism H3 is canceled by the field H4 produced in the cancellation coil 8.
[0065] Although illustration and explanation are omitted, all the examples of this invention can use them for the magnetic cancellation equipment shown in drawing 27 and drawing 28 .
[0066]
[Effect of the Invention] As stated above, according to this invention, the circuit output characteristics to external magnetic field strength can offer the magnetic detector which made effect by the property variation of an ambient temperature or a magnetometric sensor hard to be influenced as much as possible, and aimed at improvement in precision of circuit output characteristics to external magnetic field strength.

[Translation done.]

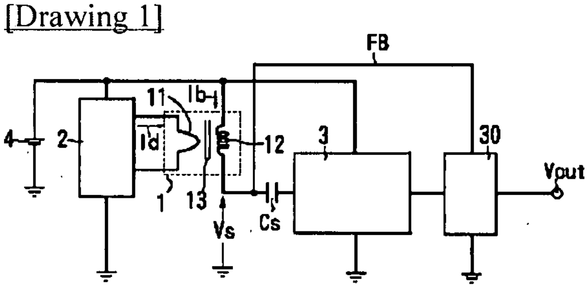
* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

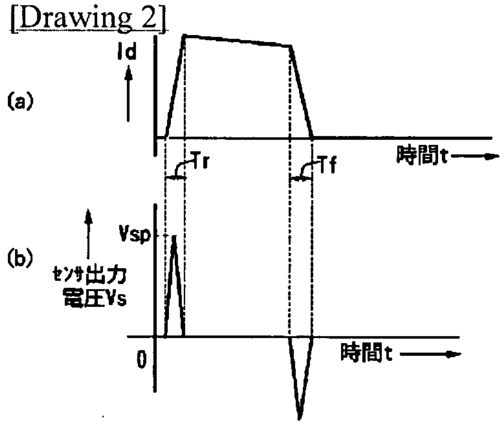
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

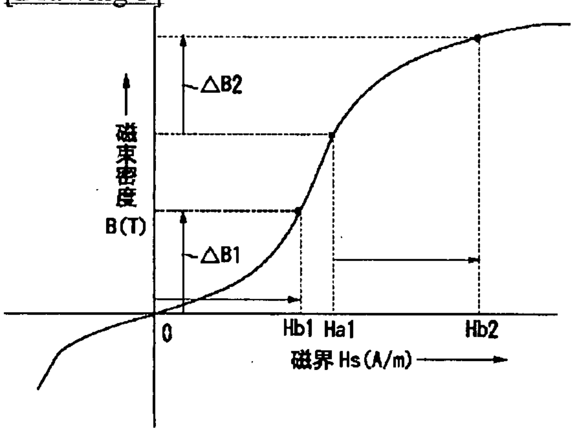
[Drawing 1]



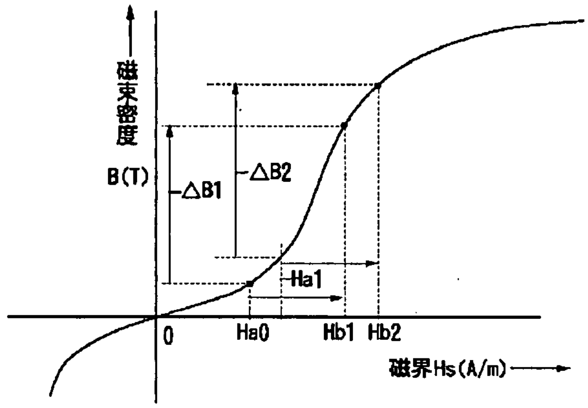
[Drawing 2]



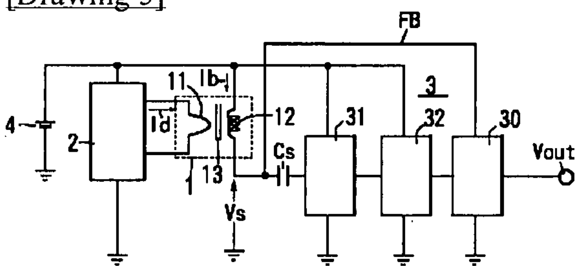
[Drawing 3]



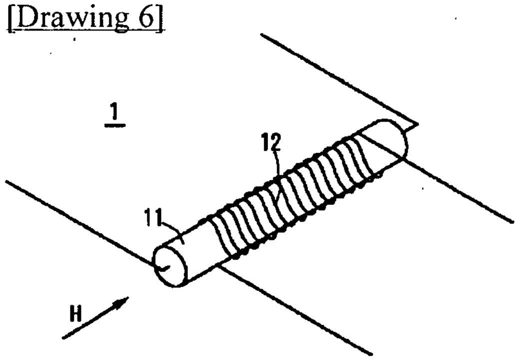
[Drawing 4]



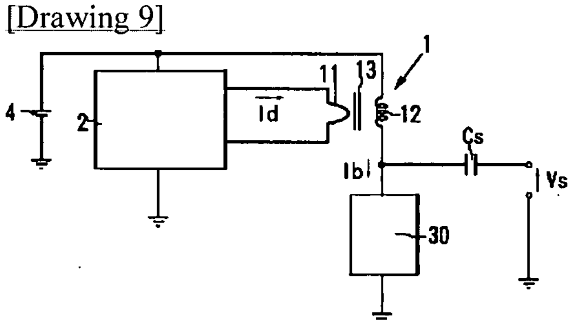
[Drawing 5]



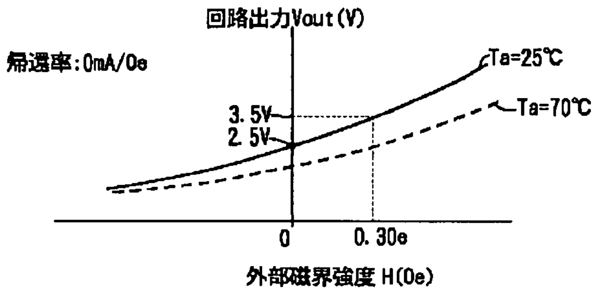
[Drawing 6]



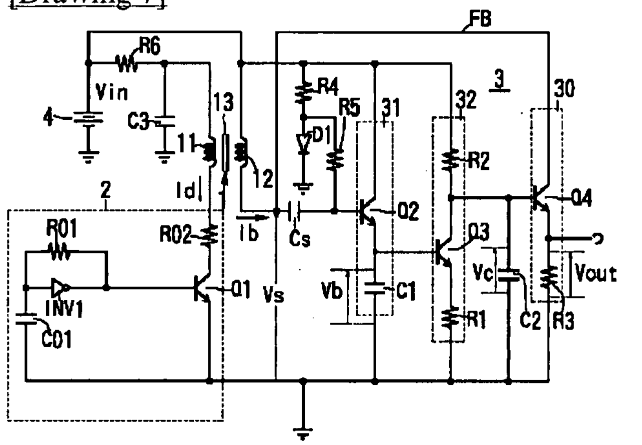
[Drawing 9]



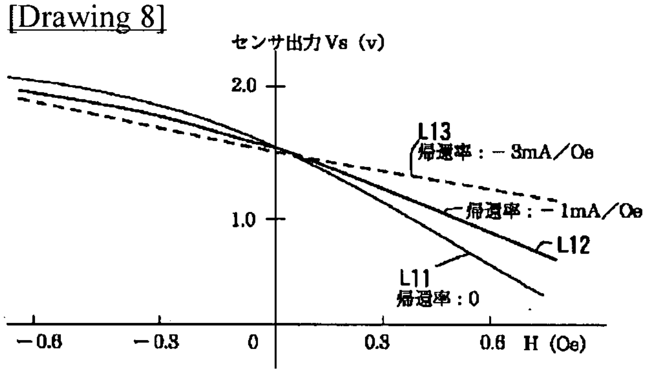
[Drawing 13]



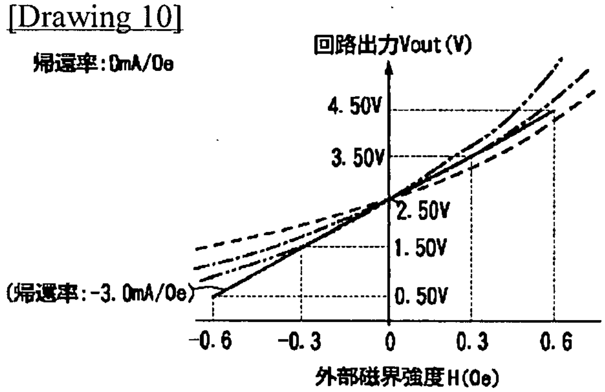
[Drawing 7]



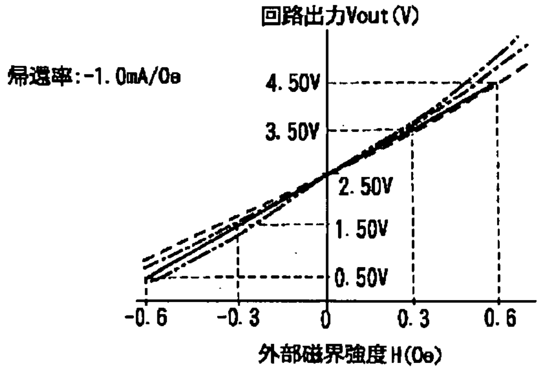
[Drawing 8]



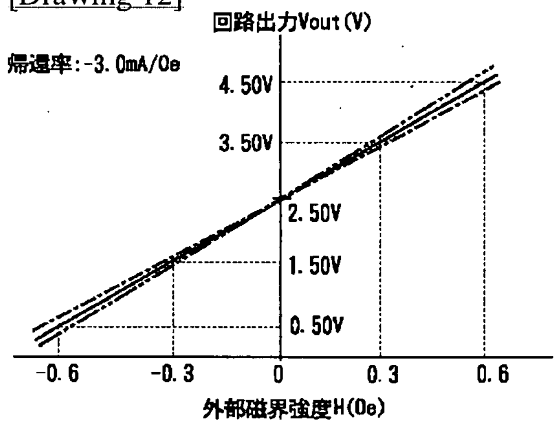
[Drawing 10]



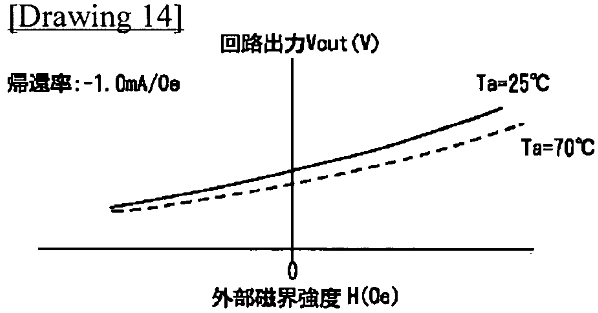
[Drawing 11]



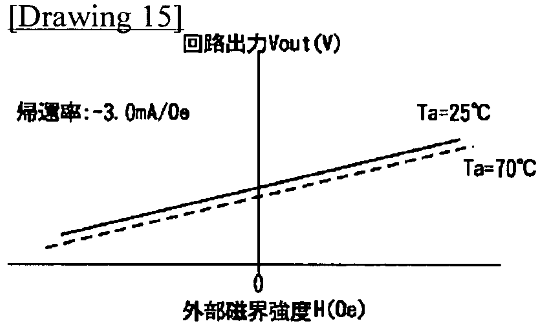
[Drawing 12]



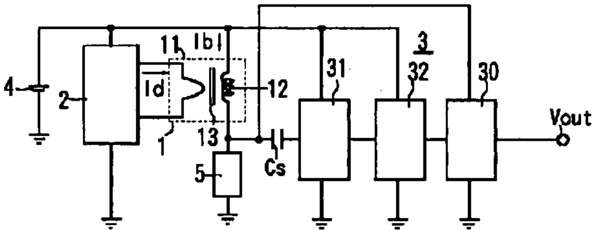
[Drawing 14]



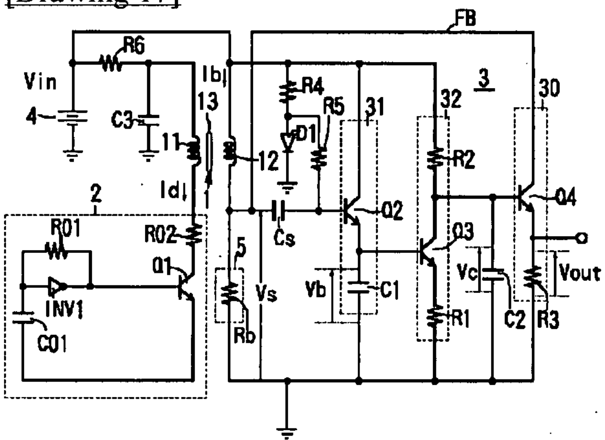
[Drawing 15]



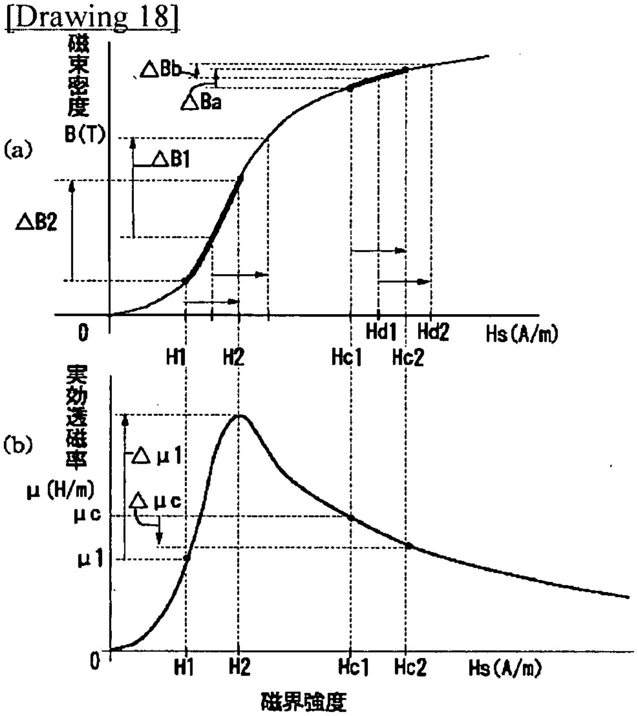
[Drawing 16]



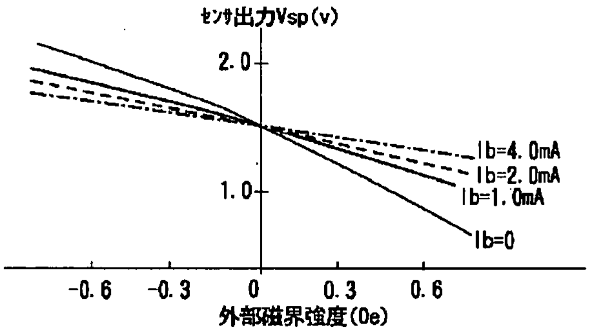
[Drawing 17]



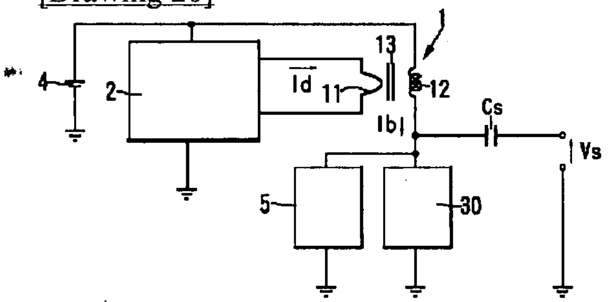
[Drawing 18]



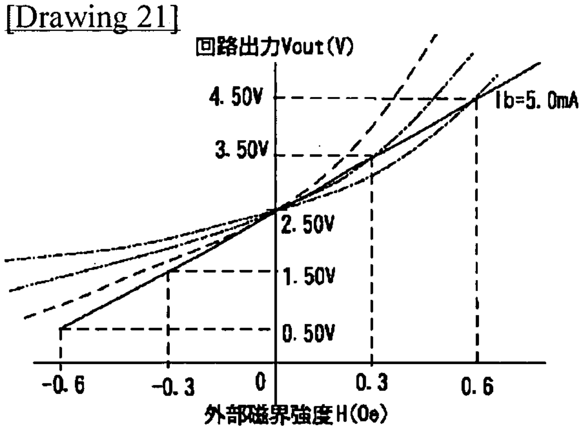
[Drawing 19]



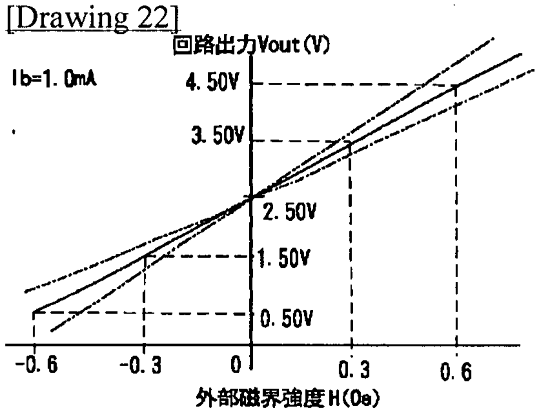
[Drawing 20]



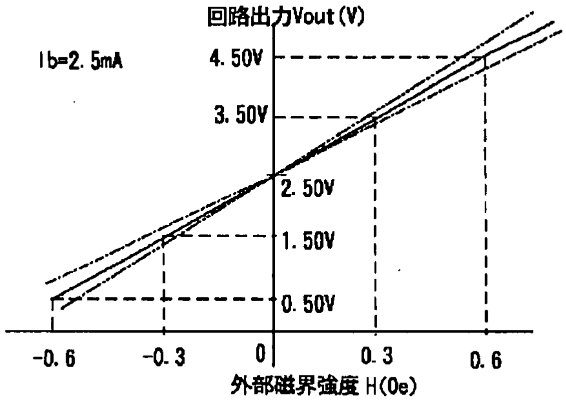
[Drawing 21]



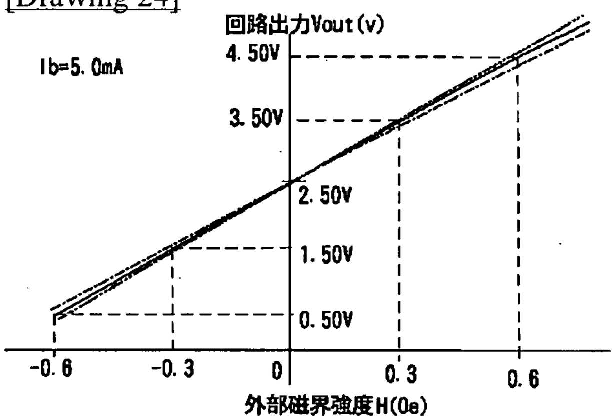
[Drawing 22]



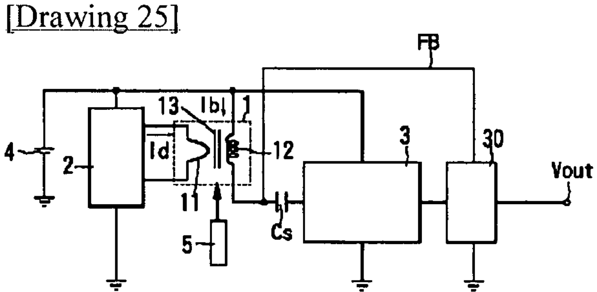
[Drawing 23]



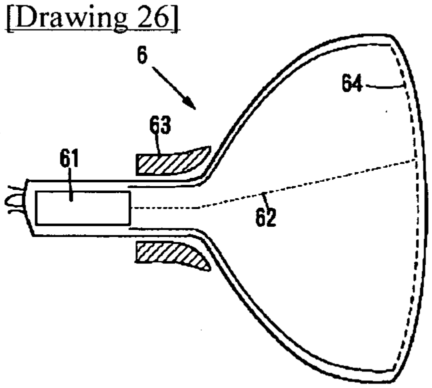
[Drawing 24]



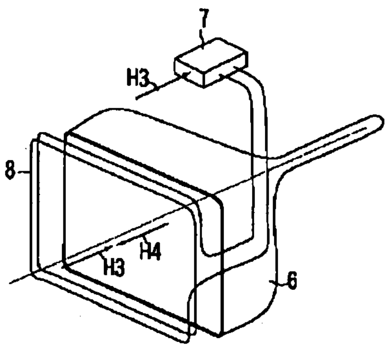
[Drawing 25]



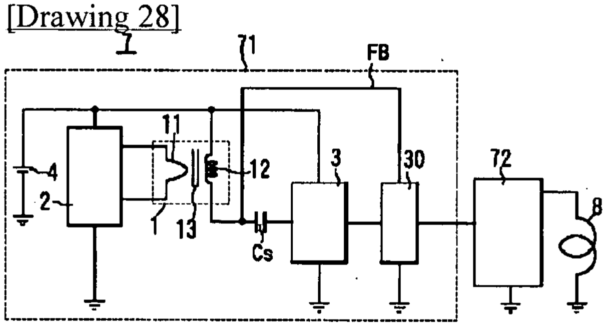
[Drawing 26]



[Drawing 27]



[Drawing 28]



[Translation done.]